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(54) **MIXING REACTIONS BY TEMPERATURE GRADIENT FOCUSING**

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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,810,985 A * 9/1998 Bao et al. 204/451
7,029,561 B2 * 4/2006 Ross et al. 204/451

OTHER PUBLICATIONS

Zhu, Spatial temperature gradient capillary electrophoresis for DNA mutation detection, *Electrophoresis* 2001, 22, 3683-3687.*

* cited by examiner

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(57) **ABSTRACT**

A method is provided for observing mixing interactions and reactions of two materials in a fluid. The method in one form provides for concentrating by balancing electrophoretic velocities of a material against the bulk flow of fluid in the presence of a temperature gradient. Using an appropriate fluid, the temperature gradient can generate a corresponding gradient in the electrophoretic velocity of the material so that the electrophoretic and bulk velocities sum to zero at a unique position and the material will be focused at that position. A second material can then be introduced into the fluid and allowed to move through and interact with the focused band of the first material. Products of the interaction can then be detected as they are focused at a different position along the gradient. The method can be adapted to study the temperature dependence of the molecular interaction.

29 Claims, 9 Drawing Sheets

